



CHAPTER 10

**Status of Korean Navy's Tactical C4ISR
Systems Acquisition and Issues on
Interoperability between ROK-U.S.
Combined Naval Operations***Young-Kil Kim***Introduction**

This chapter presents the historical background of the ROK Navy's C4I systems acquisition, discusses the status of Navy tactical C4I system development program and addresses some issues on interoperability for combined naval operations.

The Korean Navy's C4I related systems developed and/or being developed include surface ship's combat systems, KNTDS, TSC, KOED. The combat systems and KNTDS were developed based on commercial contracts, while the TSC and KOED systems were acquired via foreign military sales from U.S. government.

Currently, Korean Navy is implementing the naval tactical command, control, communications, and intelligence system acquisition program. A major goal of the program is the acquisition of automated command and control systems to support the Korean Navy's tactical operations.

The main functions of the NTC4I system will include automated tactical data and information fusions from multiple sources and dissemination of the fused information, tactical displays for tactical commanders' situation awareness and decision-making aides, direct orders to subordinate forces, and monitor the mission execution in real time.

One of the major issues and challenges in the NTC4I system development involves the implementation of joint interoperability among Korean armed forces and combined interoperability with the U.S. Navy and other allied forces. This chapter focuses on combined interoperability issues facing the ROK-U.S. Navy's combined operations.

Historical background

Since the early 1990s, the Korean Navy has started to procure some automated command and control systems to be used for surface combatants and fleet level command centers, or for maritime patrol aircraft ground support. For instance, combat systems on Korean destroyer next-generation (KDX-I, II, and III) surface ships, tactical support center system for P-3C MPA operations support, Korean Navy's tactical data systems Batch I and II, Korean ocean surveillance and intelligence system baseline upgrade evolutionary development, called KOED, for naval intelligence dissemination.

The KDX combat systems, conducted in 3 phases (divided into KDX-I, II, and III), incorporate a ship's own sensors, weapons, and command and control functions. The combat system on board the KDX-I, called SSCS MK-7, was developed in the mid-1990s on a commercial basis by Great Britain's BAE Sema and the Netherlands' Signaal (now Thales). BAE has developed the command and

control part and Signaal the weapon control part. The SSCS MK-7 combat system fuses sensor data from ship's own sensors; evaluates threats and target priorities; plans engagement (e.g., AAW, ASUW); and launches weapons automatically, semi-automatically, or manually depending on the mode selection. For the KDX-II ships, SSCS MK-7 its functionalities by adding functions for controlling Standard Missiles 2 (SM-2) and its related sensor data and rules-of-engagement processing. The combat system for KDX-III will have different configurations because the Korean Navy recently chose and contracted U.S. Navy's Aegis system rather than extending and/or upgrading the SSCS MK-7 system.

In 1994, as a package of a P-3C MPA acquisition program, the tactical support center system was procured from the U.S. Navy via FMS case. This system is virtually equivalent to the U.S. Navy TSC system, which is based on global command and control system architecture, stemmed from the U.S. Navy's joint Maritime command information system architecture. The Korean Navy's TSC system had several upgrades up to now in accordance with U.S. Navy's TSC upgrade program. As a result, the Korean Navy's TSC system has been migrated from UNIX-based architecture to Windows NT-based architecture. The TSC installed at NAS Pohang, Korea is being upgraded as if it were one of the U.S. NAS for MPAF or platform-based operational support, KNTDS was developed for connecting major surface ships, radar and missile sites, and fleet command centers via digital data links and landlines. The first KNTDS system, developed by Litton of the U. S. in the late 1990s, has been installed in ROK Navy's Second Fleet. This system showed excellent performance during the Yunpyoung battle of the West Sea a few years ago. Now the second batch KNTDS system is being developed, and it should be in IOC by next year. The second batch KNTDS

system, designed by Thales of France and being developed by Ssanyong Information and Communications of Korea, will be installed at the JCS and ROK fleets command centers, and on subordinate surface ships, radar sites, and missile sites. The system will be a commercial-off-the-shelf-based system. The Korean KOED system was purchased from the U.S. government via FMS, and its IOC was established in 2001. The KOED system is installed at MTIG in ROK Navy CINC, Chinhae and major fleet command. The KOED system has interoperability with the U.S. Navy's OED, which gives the capability of exchanging sanitized intelligence between Korean MTIG, Chinhae, and JICPAC, Hawaii. The KOED system at the MTIG will be interfaced with GCCS-K and PASS-K systems at USFK, and with KNTDS and the SI network to major Korean armed forces.

The other naval intelligence collection and analysis system will be integrated information display system, being developed by Samsung-Thales, Korea, and installed on an intelligence collection ship called Penguin. The Penguin will have an unmanned aerial vehicle on board to collect IMINT, and will be equipped with other intelligence collection devices such as SIGINT and ACINT. IIDS will have the capability of analyzing the collected information from onboard collection assets, displaying the analyzed intelligence on the tactical display, and disseminating and reporting the analyzed results to other platforms via digital data links. The Korean Navy is planning to interface the IIDS to the NTC4I and KOED systems in the future. The whole Penguin project is scheduled to be completed sometime next year.

The Korean Navy is also trying to acquire the U.S. Navy's GCCS-M system via FMS in order to support U.S.-ROK Combined Naval Operations. This GCCS-M acquisition

program is a result of the U.S. Navy's recommendation based on several combined exercises. During the series of recent combined exercises, the U.S. Navy and ROK Navy have suffered from inefficiencies in conducting naval operations due to lack of real-time information sharing. The U.S. Navy seemed to have judged this happened because ROK Navy did not have any system to support real-time information exchange for the combined operations. The ROK Navy will install the GCCS-M systems on flagship-level surface combatants. But the operation of the GCCS-M system is likely to be confined to combined exercise and operation periods only. The current means of interfacing GCCS-M systems on board the ROKN and USN ships is via the U.S. Navy's SATCOM as a primary channel and HF data link via USN NTDS and ROK KNTDS as a secondary. For the primary interface, ROKN ships with GCCS-M will be equipped with Mini-DAMA SATCOM receivers.

As described above, the Korean Navy already has several command and control systems, and is pursuing more systems. Some were either acquired as a package of major platform/weapon systems acquisition programs or as stand-alone systems. Some were either developed on commercial bases from domestic or foreign industries or directly procured from the U.S. government via FMS. The most current concerns are how to integrate these smaller systems. Though the Korean Navy plans to implement interoperability among those systems through the NTC4I system, many issues and challenges remain.

Henceforth, this chapter presents and discusses major issues on interoperability, especially focusing on the combined interoperability between the Korean Navy's NTC4I system and the U.S. Navy's GCCS-M, in terms of both operational and technical levels.

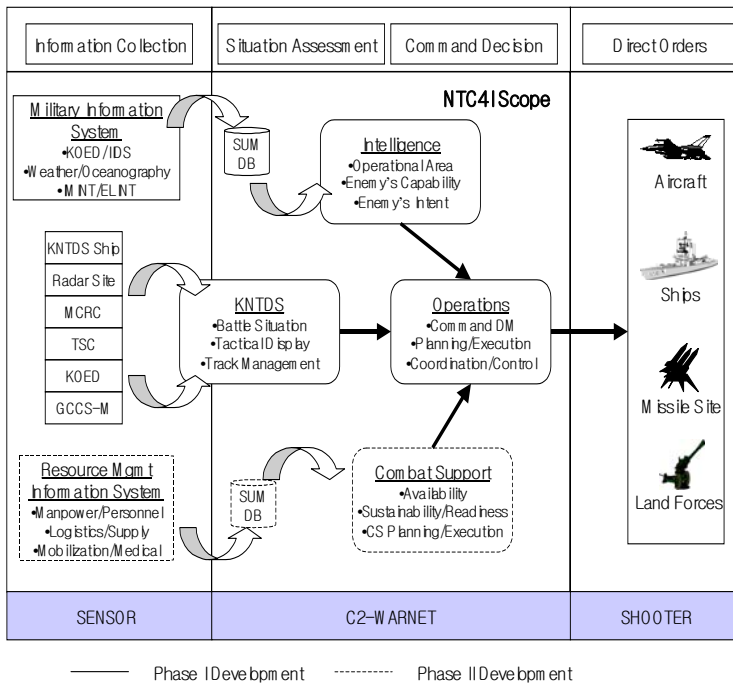
NTC4I System Development: Its Status and Building Concepts

The Korean NTC4I system is being developed from the 2003 to 2008. The program will be executed in two phases: the first phase, 2003 to 2005, includes development of core functions, focusing on intelligence and operations domain tasks. In the second phase, the functions of developed system in the first phase will be extended and interfaced with joint and combined command and control systems and Navy's combat support system. This year is a pre-development, conceptual study phase. During this conceptual study phase, the system requirements, preliminary system specifications, and preliminary system's architecture design are being developed. The Korean Navy has contracted the conceptual study project with Samsung Data Systems, Korea. This project will be concluded by the end of this year.

Operational Concepts

The ultimate NTC4I system will have three major functions: intelligence, operations and combat support functions in order to provide commanders with enhanced capability in situation analysis, and command decision-making. Figure 10.1 shows the conceptual flows of tasks and information of the NTC4I system. The figure also implies the interface concepts. Ultimately, the NTC4I system will implement the sensor-C2-shooter connectivity.

Figure 10.1. CONOPS of the Korean NTC4I System



The intelligence component will perform an analysis of the operational area, enemy's capability, and enemy's intents. The intelligence component will have the ability to access the summary database from other military intelligence systems including KOED and IIDS, as well as weather information systems, oceanographic information systems, and IMINT and ELINT analysis systems. The intelligence component will feed any requested or analyzed information to the operations component.

The operations component will perform functions such as tactical display, command decision-making and tactical decision aids, planning and execution monitoring, coordination, and control. The tactical display function will be basically based on KNTDS track inputs; hence many

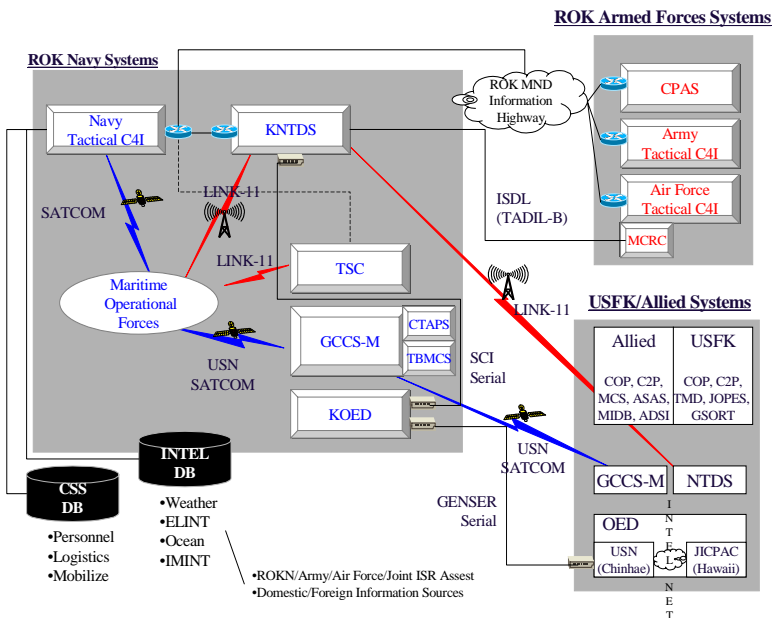
algorithms and modules of KNTDS second batch will be adapted to NTC4I software development. Since the KNTDS system will be interfaced with a ship's combat systems, KOED, TSC, and GCCS-M of the ROK Navy and the MCRC system of the ROK Air Force, all the tactical tracks of surface, subsurface, and air will be fed into the NTC4I system. This will allow command teams of the Korean Navy's battle group and commanders to have CTP, that display the targets from both organic and non-organic multiple sensors of the assets of ROK armed forces, and U.S. Navy. This will enhance the capability of situational awareness of the naval battlefield and synchronized command decision-making. To accomplish this, the NTC4I system must realize joint and combined interoperability.

For the purpose of supporting any operational planning, the combat support component will be integrated within the NTC4I system. The combat support component, which is scheduled to be developed in the second phase of the program, will provide the operations component a summary database extracted from the resource management information systems, which were or will be developed as separate acquisition programs. The combat support component will perform the analysis of force's availability, sustainability, and readiness in terms of manpower and personnel, logistics, mobilization, combat medics, and others. Any combat support commanders and staffs will have COP capability together with combat support functionality so that they can synchronize combat support planning and execution in harmony with changes of operational situations.

System Concepts – Interoperability View

Figure 10.2 shows the connectivity view of the ROKN's C4I systems. The NTC4I system will be designed to incorporate all the Navy's organic C4I systems and ISR assets by interconnecting and interfacing them. For primary communication, all NTC4I-equipped ships will be interconnected by Korean military SATCOM to be launched in the near future. The KNTDS ships and TSC and P-3C MPA already have Link-11 connectivity, and non-KNTDS ships have Link-14 connectivity. The KOED system will have SCI serial interface to KNTDS, which will hand over the received data to NTC4I system.

Figure 10.2 Connectivity of the NTC4I System



KNTDS will remain as an independent system up to the completion of the first phase of the NTC4I program and be

interfaced to the co-located NTC4I system via serial interface. During the second phase of the NTC4I development or later upgrade program, the KNTDS will ultimately be incorporated into the NTC4I system forming a single, integrated system.

During the combined operations with the U.S. Navy, the U.S. Navy's SATCOM will provide connectivity between ROKN GCCS-M and USN GCCS-M. KNTDS ships will have Link-11 connectivity with USN NTDS ships at a preset frequency. The ROK Navy's NTC4I system will have connectivity to CPAS installed at CINC or higher level for strategic command and control, and the Army and Air Forces' tactical C4I systems through the MND's information highway, which will be built in the future. This will provide the ROK Navy joint interoperability. ROKN KNTDS already has connectivity to ROKAF MCRC via landline, called Inter-Site Data Link, based on TADIL-B protocol.

For combined interoperability, USFK and CFC will primarily use landlines. USFK and CFC now have C4I capabilities, such as COP, C2P, MCS, ASAS, MIDB, JOPES, GSORT, TMD systems. Most systems operated by the USFK and CFC are for land warfare and air defense missions; systems for naval operations are scarce and restricted in information dissemination to ROK forces. Only extremely sanitized intelligence is released to the ROK JCS.

For combined naval operations, the U.S. and ROK can use the GCCS-M, KNTDS, and KOED systems. GCCS-M systems for ROK and U.S. Navies will have the same configuration and will be interoperable via USN SATCOM. KNTDS has Link-11 connectivity capability with USN NTDS. Hence, obtaining interoperability during combined operations will be a matter of procedure. However, Korean

NTDS does not have SATCOM capability, while the U.S. NTDS does. The KOED at MTIG, Chinhae has the GENSER serial interface to USN OED, Chinhae, which uses USN intelnet to JICPAC, Hawaii, giving interoperability between Korean MTIG and U.S. JICPAC. The ROK and U.S. Navies will exchange sanitized intelligence via KOED/OED connection. ROKN TSC can also have interoperability to USN TSC. However, this will not be direct connectivity, but indirect connectivity through Link-11 relay by airborne MPAs. This will allow ROKN TSC to relay limited tactical information to sea-based ROKN forces from USN TSC sources, or vice versa.

More Futuristic Aspects of Interoperability

Even though not specifically realized yet, the ROK Navy is pursuing the cooperative engagement capability for the future. Viewing the capability of the CEC system, ROKN can employ the CEC for joint air defense and combined missile defense operations. Since the KDX-III will have an Aegis combat system and SM-2 (or possibly SM-3) surface-to-air missiles, those can be used for joint air defense with the Air Force's air defense weapon systems and for combined missile defense with USN Aegis ships and even with Patriot batteries within the Korean Peninsula theaters.

If the ROK Air Force has the capability of AWACS and Link-16, this will enhance the cooperative and coordinated operations in the air and missile defense missions with the Navy's Aegis ships. When the C4I systems of each service, CEC, AWACS, and Link-16 capabilities are obtained, they will form the network-centric operations capability in joint air and missile defense. The CEC, when acquisitioned by ROK Navy, will be needed to interface with Korean NTC4I, KNTDS, and combat systems. For joint air and

missile defense, the CEC needs to be installed at the Air Force's SAM batteries and MCRC.

If USFK air defense systems, e.g. Patriot batteries, have CEC capability and if the ROK has CEC capability, combined air and missile defense will be possible. When this happens, the Korean Peninsula's air and missile defense capability and effectiveness could be multiplied; hence the security of the peninsula will advance several steps with less investment by either the U.S. or the ROK.

A Suggested Approach to Achieve Interoperability in the ROK Armed Forces

ROK Navy's Interoperability Requirements

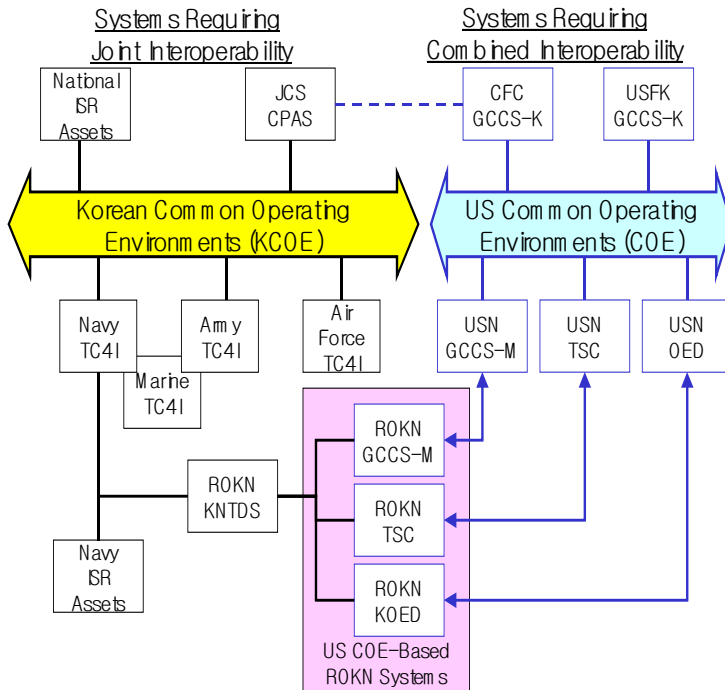
The interoperability issues in Korean armed forces are not the Army's, Air Force's, or Navy's only, but those to be resolved jointly in close coordination among services, JCS, and agencies. Not only the joint interoperability among Korean armed forces, but also the combined interoperability between Korean and U.S. armed forces, and Korean and other allied forces or civilian sector is required. Specifically, for more effective and efficient combined operations, Korean and U.S. systems should have full interoperability.

The joint/combined interoperability requirement of ROKN NTC4I system as well as Army and Air Force's tactical C4I systems is presented in Figure 10.3. A Korean KCOE, as distinguished from the U.S. COE, and which must be developed in the future, will play the role of providing the basis of joint interoperability and interface in Korean armed forces. The Korean Navy already has some U.S. COE-based systems such as TSC, KOED, and GCCS-M on shore bases and on board ships. The question is how the Korean

Navy, other services, and the JCS will develop a KCOE that is compatible with the U.S. COE.

Though not shown in Figure 10.3, the ROK Air Force has a TBMCS that is based on U.S. COE. This system needs combined interoperability with U.S. Air Force systems. USFK is requesting ROKAF to interface MCRC system with U.S. systems. On a strategic level, the ROK JCS has CPAS, while CFC and USFK installed GCCS-K. For the combined interoperability at the strategic level, the CPAS and GCCS-K systems will need full interoperability via direct system-to-system interface. Since the current CPAS is a stand-alone system, it is unlikely to have interfacing ability with the U.S. COE-based GCCS-K system. Currently, these systems are operated offline, though they are physically co-located. Hence, the CPAS will need upgrades in the future to have full combined interoperability at the strategic level in the Korean theater.

Figure 10.3. ROK Navy's Joint/Combined Interoperability Requirements



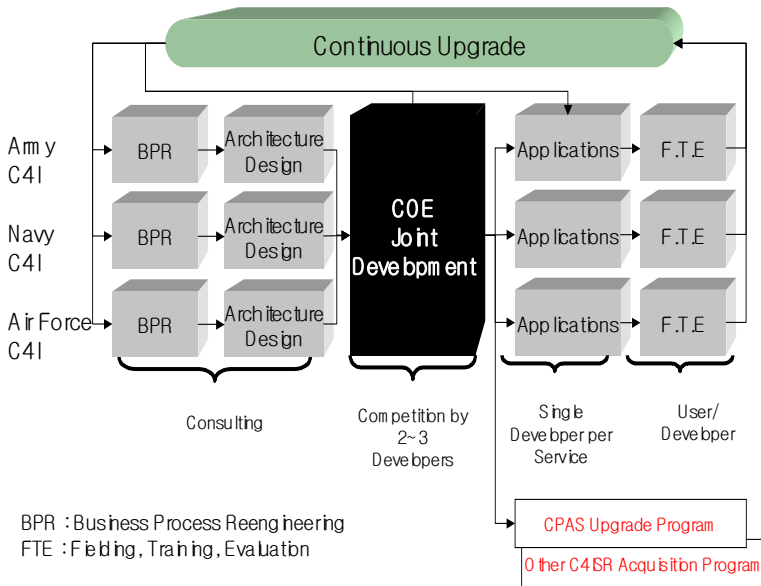
Suggested Approach for ROK Interoperability

A few years ago, the author suggested a conceptual approach to achieve joint and combined interoperability in C4ISR systems. The basic idea of the conceptual approach is the development of a KCOE and KCOE-based C4I application systems. Because of the rapid evolution of IT, and the current status of such a short time remaining to the start of tactical C4I system program because of each

service's competitive strategy in C4I acquisition, Korean MND and each service can have two basic options to implement the conceptual approach.

Option 1 is that the JCS and each service jointly develop standard COE components before the main development of the tactical C4I applications. This option requires a working group consisting of representatives from each service, agency, JCS, and MND to identify scope, functions, architectures, technology, and standard formats of KCOE components. To implement this option, each service and agency that has plans/programs/budgets to develop tactical level C4I systems should share in the burdens and budgets. Since the Army, Air Force, and Navy have already completed business process reengineering and operational architecture studies, it may be relatively easy to identify functionalities to be implemented as KCOE components. Figure 10.4 shows the conceptual process of Option 1 for interoperability realization of Korean armed services via a joint KCOE-based C4I development program. One advantage of this option is that it may be an ideal approach in that an integrated development is advantageous in configuration management. However, it now lacks sufficient time to prepare because of the short period of time to the initiation of C4I system development program of each service.

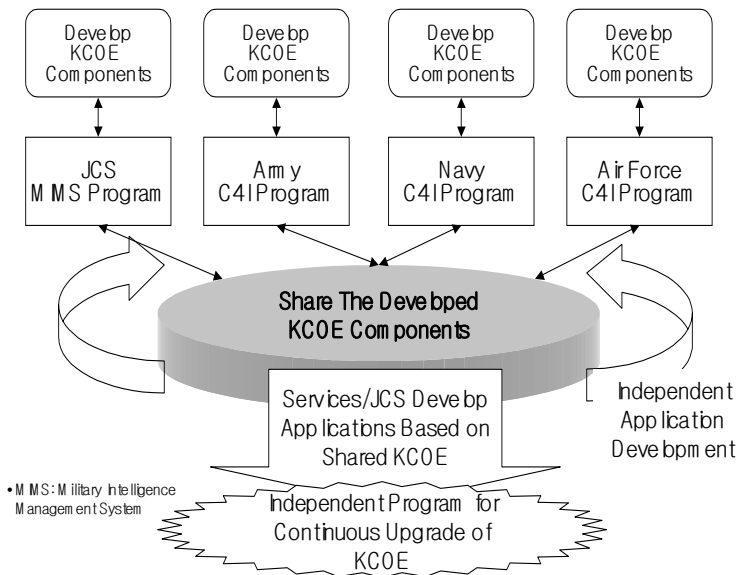
Figure 10.4. Conceptual Process for the ROK's System Interoperability Implementation - Option 1



Option 2 is that each service and the JCS together identify KCOE functionalities required and allocate development responsibilities to each service's C4I programs. They would then integrate the developed KCOE components developed by each program, and each tactical C4I application is developed based on the integrated KCOE by the services and the JCS. This option also requires a working group to identify functionalities and allocate responsibilities to develop COE components assigned. Figure 10.5 shows the conceptual process of Option 2 for interoperability realization in the Korean armed forces via partitioning responsibilities of KCOE development and

then each service develops C4I applications based on the shared KCOE components. This option could be the best in that the Korean military has a short time in terms of initiating the program on schedule, although it would be difficult to construct and maintain a cooperative program because of multiple developers and program-management organizations. However, viewing the unique situations of Korean military, Option 2 now seems more realistic.

Figure 10.5. Conceptual Process for ROK System's Interoperability Implementation- Option 2



A worst-case alternative, though not included in basic options, is to develop KCOE components as an independent program and to implement interoperability in a future upgrade. This upgrade program, especially development of KCOE components would be in charge of

the JCS. This option will be more costly and take longer than two basic options. Whichever option is taken, however, both joint and combined interoperability should be considered.

The suggested basic options discussed above are more focused on joint interoperability among Korean armed forces. In addition, the combined interoperability between ROK and U.S. armed forces should be considered. U.S. armed forces already have COE-based C4ISR systems with GCCS in their center. This means that KCOE should be technically compatible with U.S. COE in order to have sufficient interface capability. This will require very close coordination between Korea and the U.S. in technology as well as procedures. Probably the best way to have combined interoperability is that Korea develops C4ISR systems directly adopting U.S. COE components. But this contradicts the ITS acquisition policy of the Korean MND. Another problem may be the export issues of the U.S. government and Congress. In spite of these problems, combined interoperability problems need to be resolved.

Interoperability issues in combined naval operations

The U.S. Navy and ROK Navy have combined exercises almost every year. Battle groups, many MPAs, and submarines are participating in the exercises from both nations. ROKN platforms also participate in RIMPAC multinational allied exercises. As already mentioned, the most difficult thing in combined exercises is real-time information sharing on tactical situations. This is caused by the lack of automated command and control systems on the ROK side. Currently, voice channels are the major available measure for message exchange, and KNTDS seems to have constraints and limitations for full interoperability.

When the acquisition programs of KNTDS Batch II, GCCS-M and NTC4I are completed, those difficulties will be mostly resolved, allowing more extensive interoperability. However, nobody knows yet how much detail in sharing information and situation awareness until they are actually realized.

One of the most prominent issues and challenges in Korean armed forces C4I acquisition programs is that they all need both joint and combined interoperability. But the real implicit problems are that the Korean armed forces are lacking experience in developing C4I systems. They develop systems competitively in a sense, there is not enough time available to discuss the issues and find solutions before the initiation of the acquisition programs, no organization exists to drive the interoperability issues within ROK armed forces, and there are no standards, no plans, no procedures for KCOE development.

In the ROK Navy, hybrid-type C4ISR architectures exist in that the ROK Navy operates systems developed domestically, systems developed commercially by foreign developers, and systems procured by FMS from the U.S. Government. The latter two will lack any technological knowledge or information and will cost a lot for ROKN to use source codes due to proprietary right. Moreover, the FMS case bears the problem of releasability.

From the standpoint of the current status and the future planned Korean Navy's C4ISR capability, some concerns have arisen about achieving combined interoperability. First, there is no plan yet on direct connection (via LAN or serial interfaces) between GCCS-M and KNTDS and NTC4I on board ROKN ships. Most flagships and land-based command centers with GCCS-M will co-locate KNTDS and NTC4I systems. As introduced earlier in this

paper, ROKN will integrate KNTDS and NTC4I systems into a single system in the future. Any ROK ships with no GCCS-M, but participating combined operation, should exchange tactical information with USN ships through KNTDS in the near future and/or NTC4I in the far future. Double interfacing between GCCS-M and KNTDS and between KNTDS and NTC4I will increase network complexity; therefore it will decrease operational efficiency. ROK ships may also have space constraints in the CIC. This fact requires direct interface between GCCS-M and NTC4I systems. This fact also requires the NTC4I software system be developed based on the same or equivalent COE architecture with GCCS-M.

Second, for this to happen, both the ROK and U.S. need to set up formal channels to exchange technical information on the C4I or C4ISR systems. Currently, ROK-U.S (CCIB at the JCS level, technically supported by the U.S. JITC under Defense Information Systems Agency, is held twice a year on an alternate co-host basis. But this board is confined to the topics on interoperability validation tests' requirements of Korean developing systems. The pending hot issues are interoperability tests on KNTDS, MCRC, and GCCS-M. However, the CCIB tasks are not sufficient to cover all interoperability issues. Coverage of interoperability areas should be expanded to include policy-making, future command and control systems, and whole warfare and operational areas including civil-military operations other than war.

As far as technical information exchange is concerned, the U.S. government and Congress should resolve the releasability issues. The U.S. Navy and ROK Navy need to talk about the procedures via formal channel, such as ROK-U.S. Navy-to-Navy Talk. Some technical personnel exchange program may be helpful. Even though the Data

Exchange Agreement between the U.S. and ROK is in effect, the exchange of information is limited to technical data on specific weapon systems on-demand basis because the Agency for Defense Development of Korea is designated as the formal channel. More generic and comprehensive data exchange may be more valuable.

For the security of the North-East Asia region, not only the one-to-one interoperability between the ROK and the U.S., but also multinational interoperability may be required. U.S.-Korea-Japan and other Pacific Rim nations including Taiwan, ASEAN, Australia/New Zealand, possibly North and South America, or even China may need to get together for future cooperation and interoperability for the sake of regional security. For the OOTW, not only the military level but also civilian area (such as NGO's, International Organization) may need certain levels of interoperability. ANZUS Navies' interoperability forum can be a reference model. Navy-level combined working groups of the ROK and U.S. may be needed to set up meeting plans and agendas, raise and resolve interoperability issues, and make recommendations to the higher authorities within combined naval operations domain.

Third, in order to improve technological and skill levels for realizing and practicing combined naval interoperability, combined research program can be generated. The research can be performed by navies, or by research institutes, colleges, and developers of both countries. In addition to technical personnel exchange, sharing the research results will give great help in enhancing the ability to perfect combined interoperability of both nations. Korean colleges have some research centers, though in infancy phase. They could cooperate with U.S. research centers in colleges or other organizations to the combined research programs in the interoperability area.

Fourth, the ROK Navy's program management personnel need to be aware of necessities of coordination with the U.S. Navy on combined interoperability issues from early stages of a new C4I acquisition program. For example, CEC system is in the phase of gathering consensus and conceptual study within the ROK Navy. Whoever will be in charge of the CEC acquisition program, should consider interoperability issues from the initial stages, because that system will certainly be employed for joint/combined air and missile defense missions.

Conclusion

In this chapter, the author introduced several C4I and ISR systems that the ROK Navy has acquired, is developing, and plans to develop in the future. Among these systems, the NTC4I system will be the center of future ROK Navy operations. Since the future requires ROK Navy to get involved in more joint/combined operations, ROK NTC4I must have a stronger and more comprehensive interoperability capability.

In order to enhance the combined interoperability between the U.S. and ROK Navies they may need more efforts in multiple areas. They will need to establish formal communication channel to address and resolve the practical, technical, procedural, policy-making, and even cultural and linguistic issues. Setting up Navy headquarters-level or ROKN CINC/U.S. PACOM-level talk channel and working groups for discussing and resolving the topics raised by both navies may be an option. Technical personnel exchange programs and joint/combined research programs are also suggested. For the ROKN side, interoperability considerations from the initial stage of new acquisition programs are also necessary. ☞